PN-ABT-358

VERTEBRATE PEST CONTROL PROJECT

FOOD SECURITY MANAGEMENT
POST-HARVEST MANAGEMENT

cooperative research studies
on

BIOLOGY,POPULATION DYNAMICS,ECONOMIC MPORTANCE AND CONTROL OF VERTEBRATE PESTS

RESEARCH REPORT

January 1,1991-June 30,1991

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PREFACE

This report covers the period extending from January 1,1991 through June,30,1991. During this period the following topics relating to vertebrate pest were studied:

1. Development of methods for estimating the relative densities of porcupine populations.

2. Assessment of sparrow(Passer species) damage to cereal crops in central Punjab.

3. Development of rodent control strategies in an experimental area under a wheat - sugarcane - fodder cropping pattern.

4. Studies on flock composition, flock formation, foraging and feeding habits sparrows (Passer species) in central Punjab.

Work on the control of rats and mice in farm houses could not be initiated due to non-availability of a post-graduate student. Work on this part of the project is hoped to start as soon as a suitable student is available.

By the time of writing this report 24 M.Sc., six M.Phil., and one Ph.D. students of the Department of

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Zoology & Fisheries, University of Agriculture,Faisalabad have benefited from this project on Vertebrate Pest Control. Both the research and teaching capabilities of the Department of Zoology & Fisheries has greatly improved in recent years as a result of the above cooperative research project on vertebrate pest. We are greatly indebted to Mr. Joe E. Brooks (former Team Leader) and Mr. Ejaz Ahmad (present Team Leader) for their guidance, cooperation, and support. We are cofident that the quality of our research will register further improvement in days to come.

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PROJECT TITLE: Biology and Taxonomic Status of little Indian field mouse in Punjab.

STUDENT:

Name: Shahnaz Akhtar

Degree: Ph.D.

INTRODUCTION:

Virtually nothing is known of individual or geographic variations, ecology, and reproductive biology of the little field mice of the central Punjab. To investigate, the specific status of these mice, external body, skull and bacular variations were studied under the hypothesis that two or more independent taxa constituted the booduga dunni complex of the little field mice in Punjab (Pakistan). Intuitively, if two or more idependent taxa were represented in this complex, there must be morphological, ecological and reproductive differences by which their individual recognized their own kind and achieved species isolation.

OBJECTIVES:

The objectives of this study were aimed at -

1. Examining the external body, and skull characters of the mice of booduga / dunni complex as a means of determining its taxonomic status. Analysis of bacular variations was used to supplement this effort.

2. Elucidating the fine pattern of microhabitat distrubution of the mice.

3. Describing some reproductive and demographic parameters of the mice.

ACCOMPLISHMENTS:

Body and Skull Characteristics

A total of 426 specimens of the mice of *M. booduga* complex was snap-trapped from November 1986 through December, 1988 from four districts of central Punjab(Pakistan). The characters of the fur, shape of the first upper molar(M^1) and the upper incisors were recorded for these specimens. Primarily, on the basis of the colour of the belly fur, these specimens were segregated into three forms.

In mice with pure white ventrum (PW) the dorsum was greyish brown, M^1 was variable in shape and the upper incisors were generally curved. The mice having white ventral fur with grey bases (GW) had light brown grey dorsum, variable M^1 shape and generally straighter upper incisors. The mice with light grey bellies (LG) had brownish grey, backs, slender M^1, and generally straighter upper incisors.

Morphometric relationships of the PW, GW, and LG forms of the mice were examined using discriminant analysis of body and skull characters on three sets of samples. One way analysis of variance and Duncan's Multiple Range Test revealed that head and body length (HBL), ear length (E), tail length (TV), TV/HBL, and rostral length (RL) discriminated the LG mice from PW and GW forms in all the three trials. Only inter-orbital breadth (IOB) appeared to be important in separating PW from GW mice.

The hit ratio or the classification accuracy was substantially higher than the maximum chance criterion in all thr three trials. This indicated that the discriminant model was valid.

The Mahalanobis distance analyses suggested that the centroids of LG mice, located in the reduced discriminant space, were at much greater distances (in all the three trials) from PW and GW, whereas, the distances between PW and GW were invariably much lesser (Figure 1 a, b, and c).

Discriminant analysis revealed that body weight, HBL, E, TV/HBL, and RL were important in discriminating LG mice from PW and GW mice. Upper molar row length (NRL), hindfoot length (HF), and IOB were important in discriminating between PW and GW. The LG mice weighed heavier, measured longer in HBL, had shorter tail and longer rostrum than those of PW and GW mice. The MRL and HF of GW averaged longer, while IOB averaged narrow than that of the PW mice.

<u>Bacular Characteristics</u>

The shape, seven linear measurements, and five indices of the bacula of PW, GW, and LG males were compared. In PW the proximal baculum had a pear shaped base which often tended to be rectangular in shape. The base of the bacula of GW males were largely squarish in shape; in some specimens the base tended to be pear shaped. The bases of the bacula of the LG males were generally conoid. The distal bacula of the PW and GW were deeply clefted as compared to that of the bacula of LG mice (Figures 2 to 3).

Age influenced some of the bacular measurements. Hence, the mensural data on the baculaof adults and old adults were used separately for comparing the bacula of the three forms of mice. The means of four variables , nemaly, the length of proximal baculum, lateral width of the base of the proximal baculum, dorso-ventral height of base of proximal baculum and minimum lateral width of the shaft of the proximal baculum were statistically different ($p < .05$) in both adults as well as old adults of PW of these two forms were also statistically different.

The length, minimum lateral width of shaft, and slenderness of proximal bacula of both adult and old adult PW males were significantly different from those of LG males. The lateral width of the base of proximal baculum, total bacular length, and lateral width of distal baculum of the adults of PW mice were also significantly different from those of the LG mice. The index of robustness of proximal baculum of old adults was also different from that of the LG mice.

The bacula of both the adults and old adults of GW males were statistically different from those of LG males with respect to the minimum lateral width of the shaft, and the slenderness of the proximal baculum.

The coefficient of variation (CV) value for the various bacular variables of the three forms of mice were generally larger than what has been reported in the literature for the bacula of other species of small mammals. Large CV values were related neither to age nor to the season of capture of the mice.

The length of the proximal baculum , head and body length, and skull length showed allometric trend in all the three forms of mice but with varying intensity; the relationship being generally weak.

Habitat Distribution

A number of microhabitats in the croplands as well as non-crop areas of central Punjab were sampled for the mice using mouse traps. Snap trapping comprising of 7772 trap nights resulted in the capture of 426 specimens of mice of *M. booduga* complex and 402 specimens of *M. musculus bactrianus*.

In its distribution *M. musculus* was found to be more ubiquitous than the mice of *M. booduga* complex. The former inhabited almost all the sub-habitats sampled in croplands, non-crop areas, and miscellaneous habitats . The mice of *M. booduga* complex were represented in all the samples taken from different sub-habitats of the croplands. In non-crop areas, however, these mice were not recorded from alkaline tracts, farm houses, and from the vegetation belts flanking irrigation ditches.

The mice of *M. booduga* complex favoured sandy, and sandy-loam soils while *M. musculus* attained greater abundance in loamy and moistended soil conditions.

Both BW and GW forms of mice of *M. booduga* complex had equally wide distribution (in terms of the kinds of the habitats they affected) but the former was relatively more abundant. The PW mice were found to be more abundant than the GW mice in the cotton, sugarcane, fodder, and vegetable fields as well as in the orchards. In the wheat, gram and pulses fields these two forms occurred with more or less equal abundance . Mice of the LG form were recorded from the croplands only where they were found in the wheat, cotton, graminoid fodder, and vegetable fields.

In non-crop areas only PW and GW forms of mice were recorded. In the riverine tracts, large scrublands, and sandy uplands, PW mice were predominant. In none of the non-crop habitats GW form outnumbered the PW form.

PW mice were most abundant in sandy soils and least abundant in loamy soils. The GW mice exhibited relatively high abundance in sandy-loamy soils as compared to loamy, and sandy soils. The LG mice, which were not recorded from sandy soils, exhibited maximum abundance in habitats having loamy soils.

In about 53% of the samples of mice of M. musculus and M. booduga group only one form of mice was represented, in 32% two forms were represented, in 13% of three forms, and only in 2% of the samples all the four forms of mice were represented. Wheat and sugarcane fields located close to non-crop areas exhibited maximum diversity as all the four forms of mice were represented in some of the samples taken from these fields. Occureence of three forms of mice in the same sample was recorded both from the non-crop areas as well as from croplands.

Reproduction and Population Structure

The proportion of reproductivity active males in the spring and summer samples of all the three forms of mice ranged from 90% to 100%. In the fall (PW,13.68%;

GW, 7.1%; LG, 50.0%) and winter (PW, 7.7%; GW, 29.1%; LG, 0.0%) samples the proportions of such males were much lower.

Prevalence of pregnancy in samples of adult females of the three forms of mice ranged from 58% to 100% in the spring samples and 56% to 60% in the summer samples. In the fall (PW, 7%; GW, 9%; LG, 0%) and winter(PW, 20%; GW, 18%; LG, 0%) samples the proportion of pregnant females was much lower. The annual prevalence of pregnancy in PW females was 38%, in GW 29%, and 46% in the LG females

The females of all the three forms of mice ceased reproducing during the colder months of the year. No pregnant female of PW mice was captured from November 15 through February 19 and of GW mice from October 6 through February 21. In the case of LG mice pregnant females were recorded neither in the fall nor in the winter samples.

The smallest pregnant females of PW form weighed 5.0 g and measured 58 mm in HBL, of GW form 7.0 g and 62 mm, and of LG form 8.4 g and 68 mm. The mean embryonic litter size in PW mice was 5.37 ± 1.88 (SD) (range = 3-9; n=30), in GW mice, 3.86 ± 1.95 (SD) (range = 1-6; n=7), and in LG mice it was 7.20 ± 1.69 (SD) (range= 5-9; n=5). The mean embryonic litters in PW and GW females were not different, whereas those of PW and LG females ($t = 2.045$; $p < 0.5$; df=33), and those of GW and LG ($t=3.113$; $p<0.2$; $df=10$) were statistically different.

The sex ratio (male:female) in the trapped sample of PW mice was 1:10:61 ($p<.005$; $n=246$), in the GW mice it was 1:0:45 ($p<.055$; $n=112$), and 1:1:38 ($p<.10$; $n=19$) in the LG mice.

The proportion of young mice in the annual sample of PW mice was 8%, in the sample of GW mice 12%, and in that of LG mice it was 11%.

CONCLUSIONS:

Discriminant analyses revealed that body weight, HBL, E, TV/HBL, and RL were important in discriminating LG mice from PW and GW mice. MRL, HF and IOB were important in discriminating between PW and GW. The LG mice weighed heavier, measured longer, had shorter tail, and longer rostrum than those of PW and GW mice. The MRL and HF of GW averaged longer, while IOB averaged narrower than that of the PW mice. Results of the above analysis supported separation of LG as an important species, but do not support separate specific status for PW and GW mice.

The bacula of PW males were significantly different from those of GW males with respect to four (or five) variables, and from LG bacula with respect to three (or seven) variables. The bacula of GW and LG males were not so strongly different from each other as only two variables of the bacula of these forms were statistically different. On the basis of these facts it was concluded that PW mice were different from both GW and LG mice.However, the difference between GW and LG mice was not strong.

All the specimens, of LG mice were recorded from croplands only, whereas, PW and GW mice occurred both in the croplands as well as in the non-crop areas. The PW mice appeared to prefer sandy soils, GW mice sandy-loamy soils and LG mice preferred loamy soils. Thus, the LG mice appeared to be different from the other two groups with respect to vegetation cover and soil type.

The LG females appeared to have a breeding schedule different from those of the PW and GW females. Unlike the PW and GW females , the former ceased breeding for a much longer period of time during the cold months of fall and winter seasons. The LG mice attained sexual maturity at a much higher body weight (8.4 g) and head and body length (68 mm) as compared to the PW (weight 5.0 g) and HBL 58 mm) and GW (weight 7.0 g and HBL 62 mm) the PW and GW females at statistically level. The sex ratio in trapped samples of PW and GW mice was significantly skewed in favour of the males, whereas in the sample of LG mice,females outnumbered the males. All these facts points to the fact that LG mice were different from PW and GW with respect to their reproduction and sex ratio.

The results of this study indicate that LG mice are morphologically distinct from PW and GW mice. Based upon the morphological and ecological data the specific status of LG mice should identify with _M. dunni_ and that of PW and GW with _M. booduga_, as all the available information indicates no clear separation of the latter two forms. Additional materials and biochemical and karyo-logical studies would be necessary to evaluate their relationships adequately.

It may be pointed out here that 21 specimens of PW form (skins and skulls of 15 specimens and six wet specimens), nine specimens of GW form (skins and skulls of eight specimens and one wet specimens) and 11 specimens of LG form (skins and skulls of eight specimens and three wet specimens) of mice were sent to the Mammal's Section, British Museum, London for identification. Of the 21 specimens of PW mice, 18 were positively identified as _M. booduga_, whereas, the remaining three were suspected to belong to this taxon. All the nine specimens of GW mice were identified as _M. dunni_; identify of only one of these specimens was questioned. Of the 11 specimens of LG mice, nine were positively identified as M. dunni, one was suspected to be M. dunni, and the remaining one specimen was suspected to be either M. dunni or M. cervicolor.

The above identifications seem to indicate that LG and GW mice are one and the same as all the specimens of these mice have been identified as M.dunni (17 specimens) or have been suspected to belong to this species(three specimens) . The results of the present study indicate that PW and GW mice are closer to each other than they are to the LG mice.

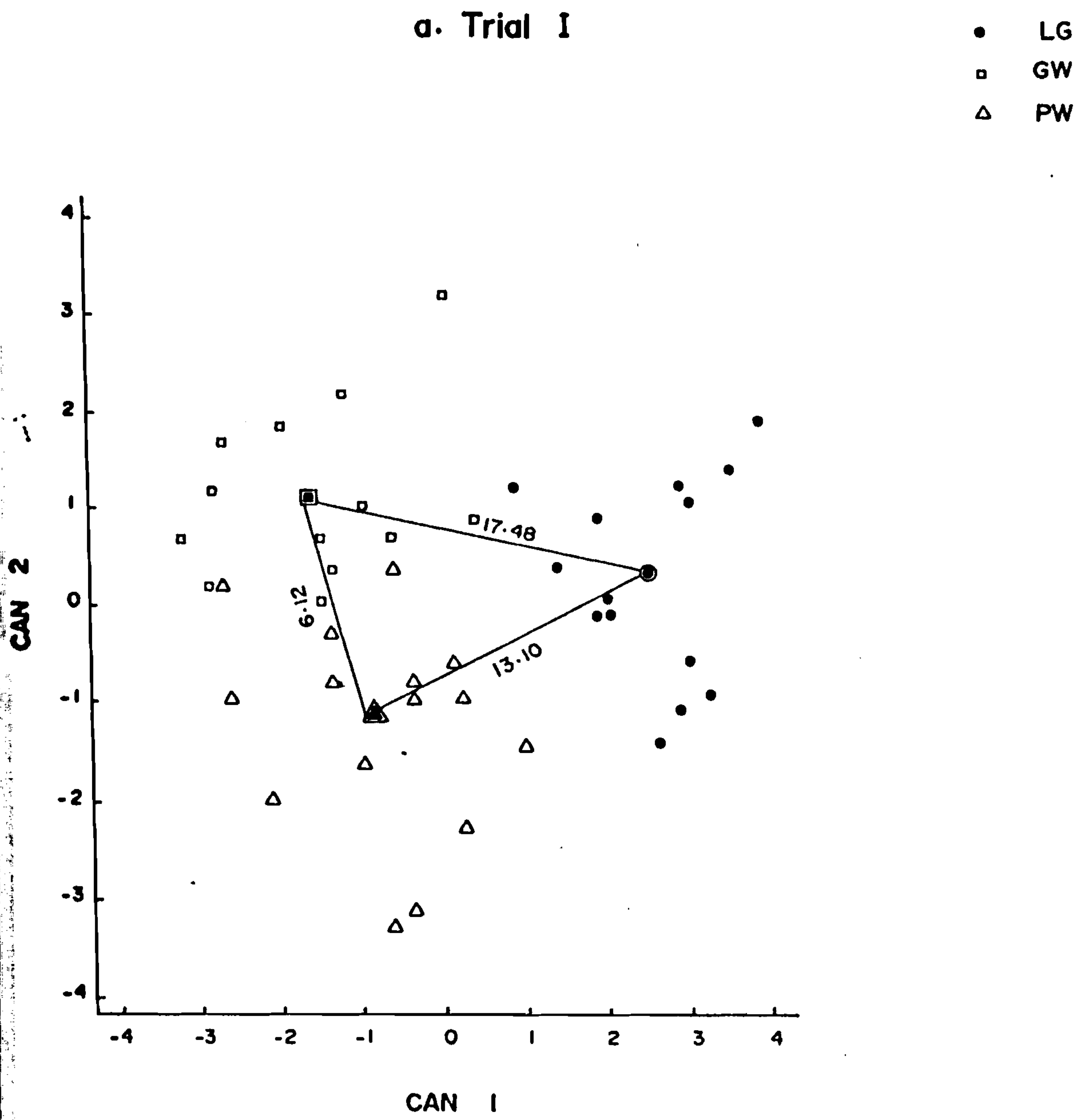
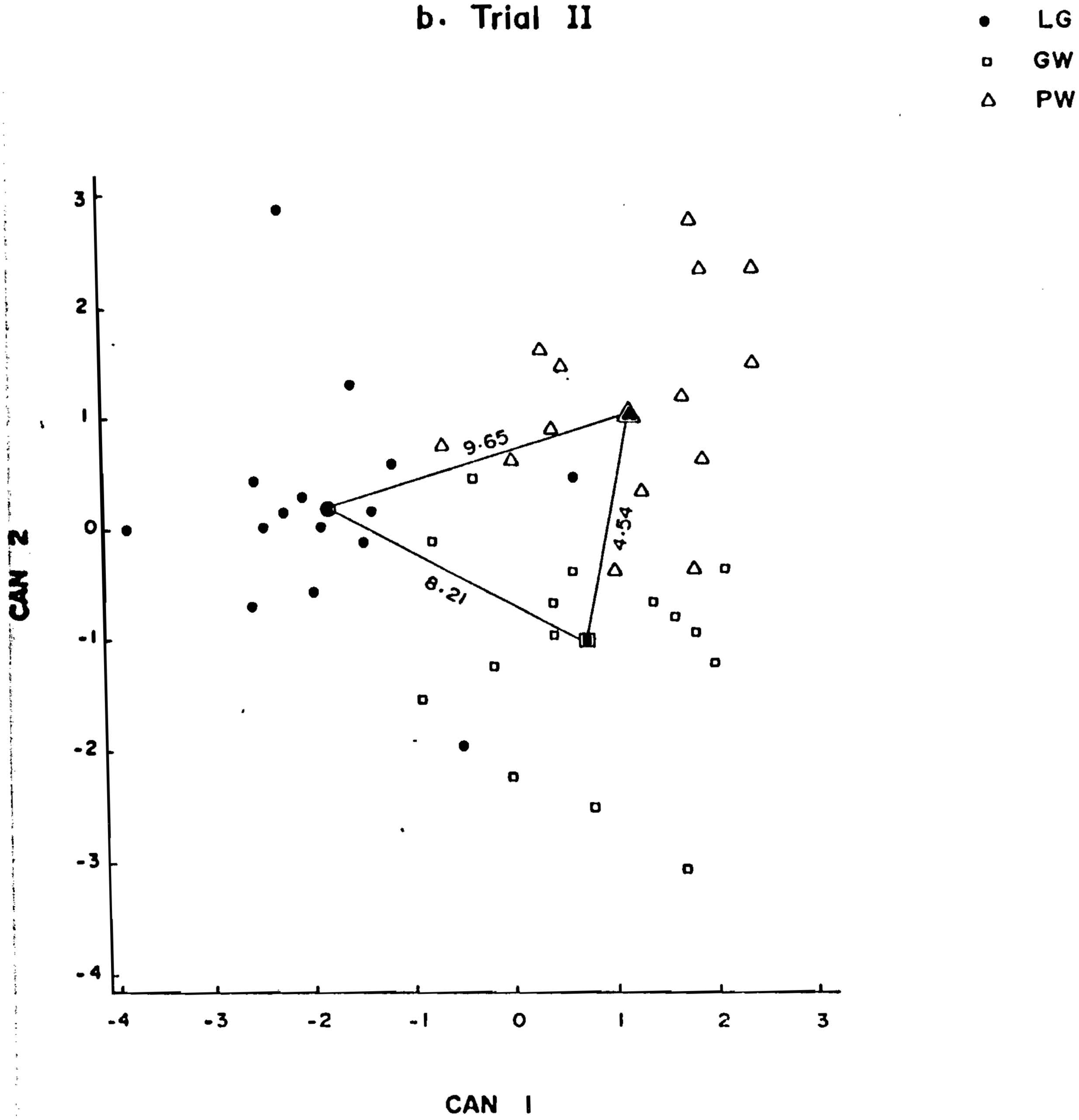
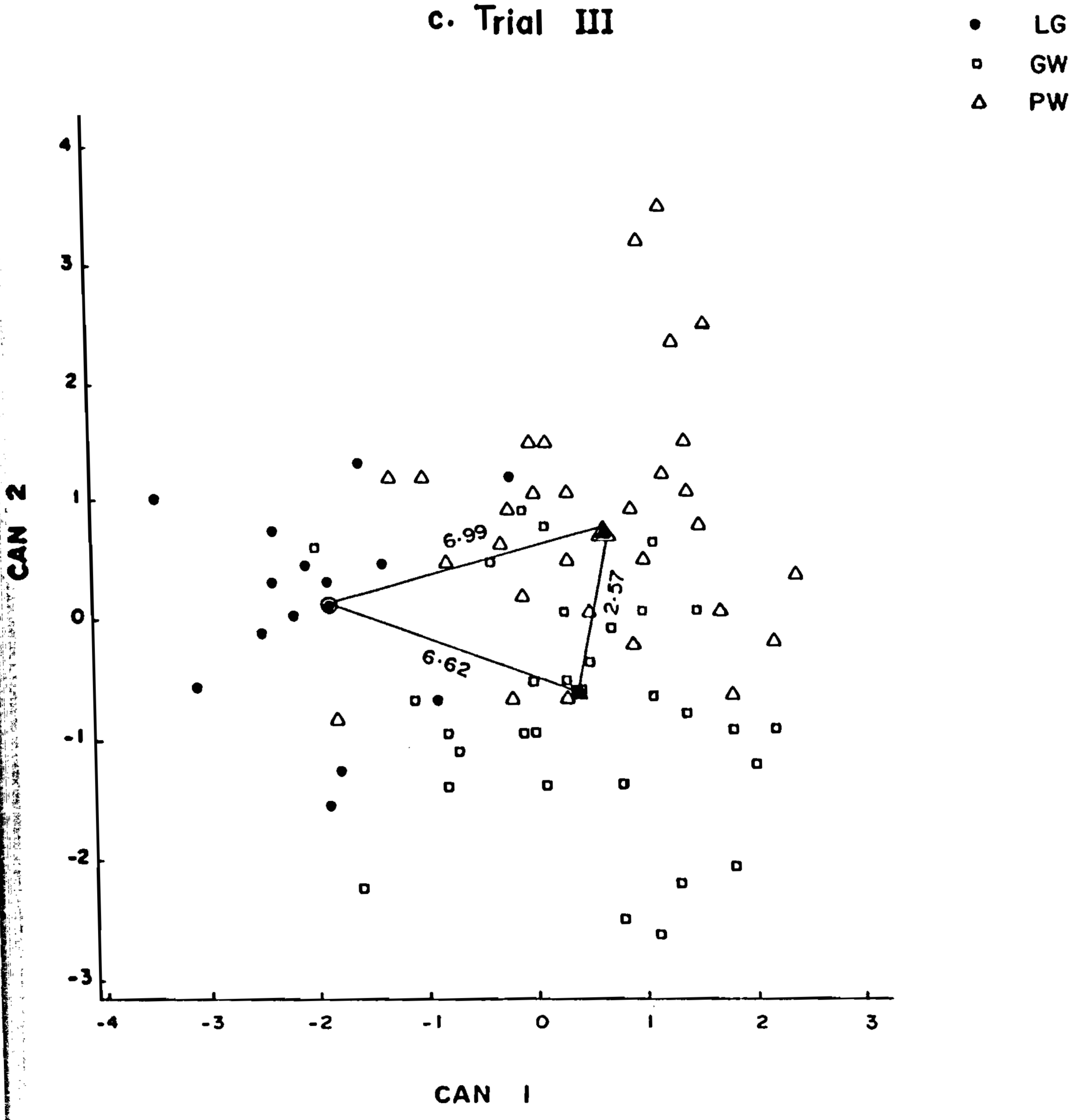


Figure 1. (a, b, and c) Plot of individual mice of the three forms of M.booduga group along the two axes of canonical discriminant space. Figures on lines indicate the Mahalanobis distance from the form centroids.

b. Trial II



c. Trial III



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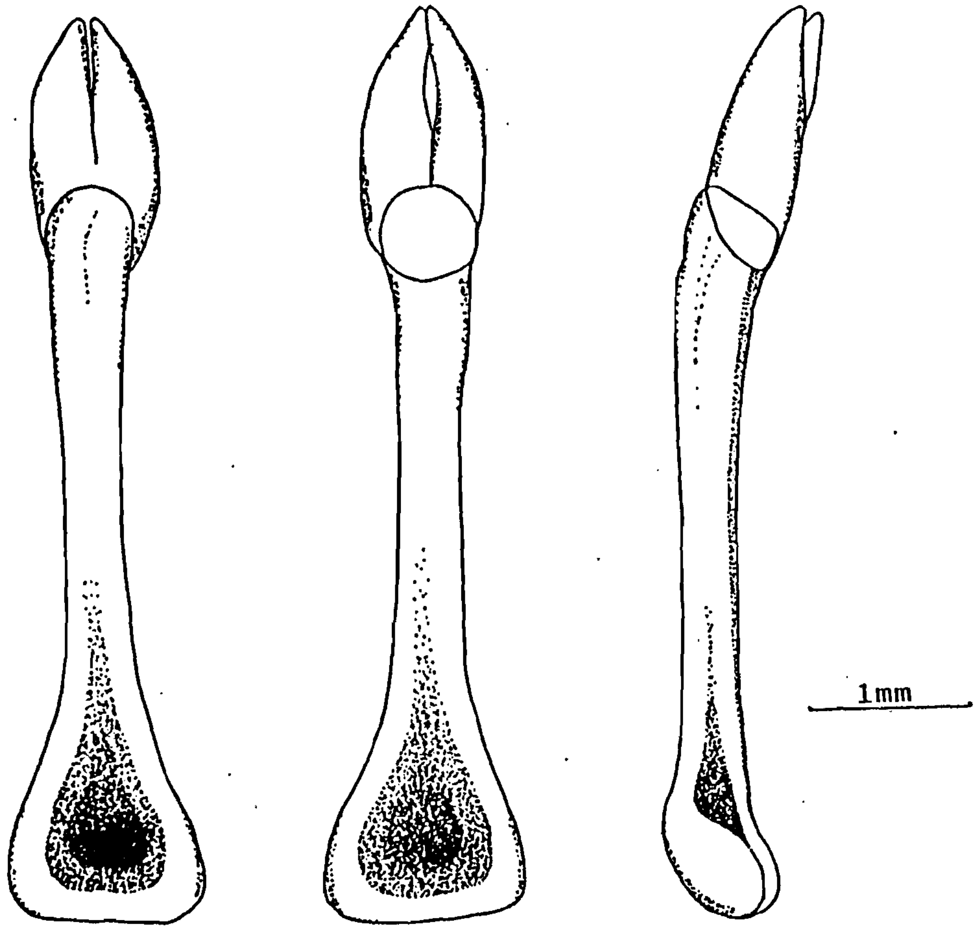

Figure 2. A typical baculum of PW form: (a) dorsal, (b) ventral, and (c) lateral views.

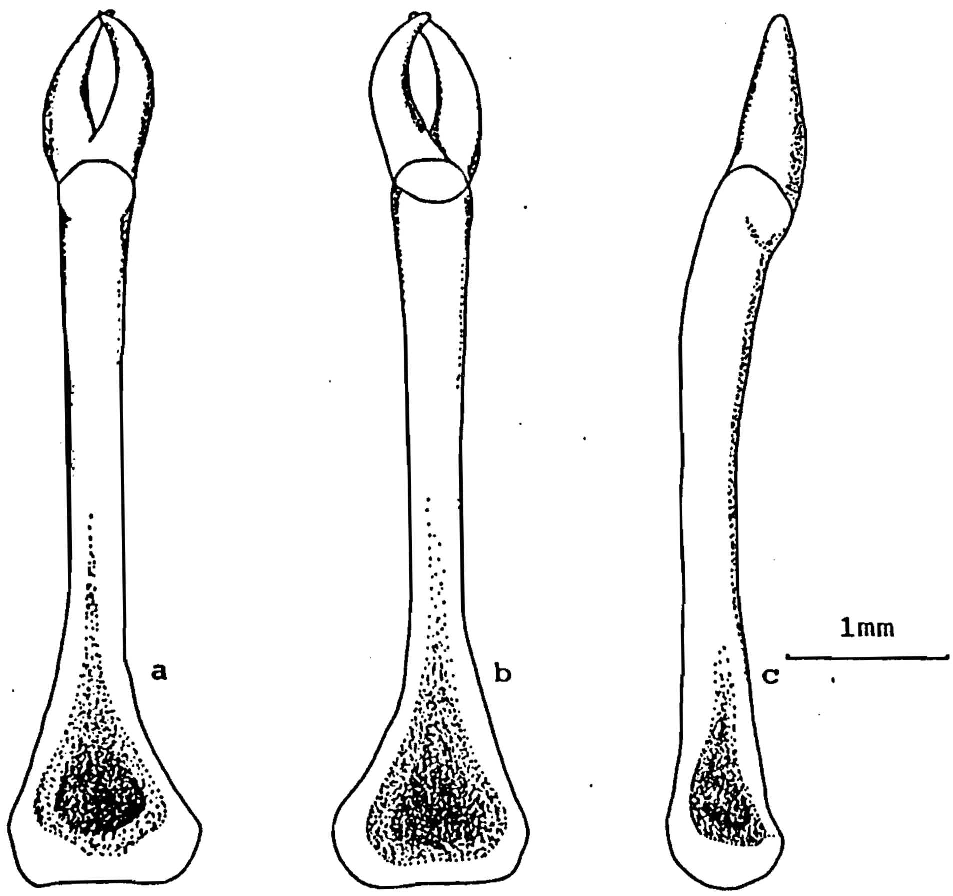

Figure 3 A typical baculum of GW form. (a) dorsal, (b) ventral, and (c) lateral views.

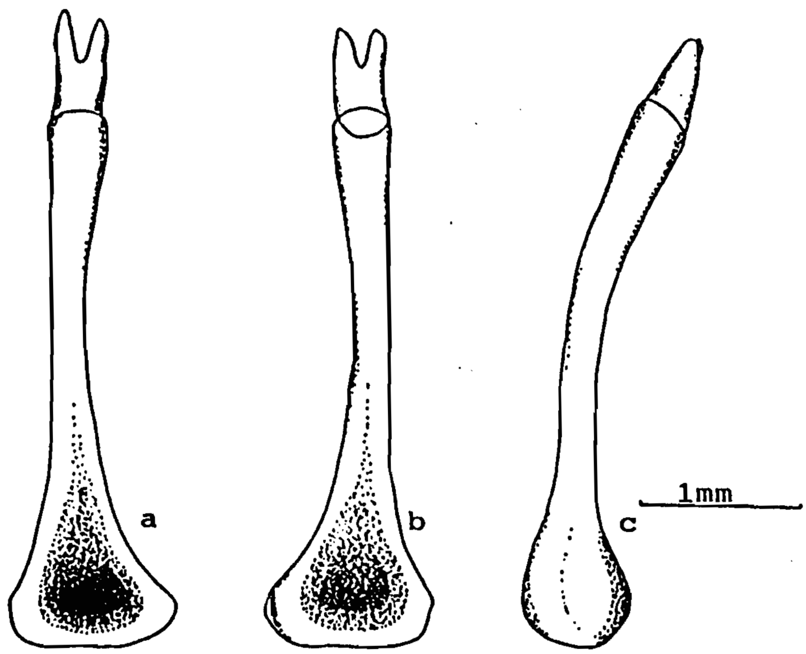

Figure A typical baculum of LG form. (a) dorsal, (b) ventral, and (c) lateral views.

PROJECT TITLE: Food Habits of Rattus rattus in Faisalabad City.

STUDENT:

Name: Munazza Jamil

Degree: M.Phil.

INTRODUCTION:

In central Punjab, the house rat(Rattus rattus) affects all sorts of human habitations viz., crowded cities, towns, villages and even the farm houses located in the croplands. Recently attempts have been made for estimating the population density of the rat in different types of rural and urban structures. Alongwith the density data, information on the food habits of the rat will be instrumental in assessing its economic importance. Furthermore, adequate information on the food and feeding habits of the animals is vital to a proper understanding of their ecology, mode of life, and indeed their control.

OBJECTIVE:

The present study was aimed at knowing about the food habits of the house rats living in some selected structures in Faisalabad city viz., residential houses, grain shops, sweet shops, and grocery shops.

ACCOMPLISHMENTS:

During the period extending from June,1989 through May,1990, a total of 425 specimens of the house rat (*Rattus rattus*) was captured from grain shops, residential houses, sweet shops, and grocery shops in Faisalabad city.

An analysis of stomach contents of 130 house rats from the grain shops revealed presence of 19 food itsms (Table 1). Among these wheat was the most intensively consumed item; it contributed 31.2% to the total dry weight of the contents. Rice (14.9%), gram (14.3%) and insects (10.8%) were the other important items of the rat's diet.Unidentified plant tissues constituted 5.2% of total dry weight and unidentified food matters constituted 3.9%. Miscellaneous items accounted for 6.5% of total dry weight.

An analysis of the stomach contents of 128 rats from residential houses showed that they drew nutriment from 16 species of plants (Table 1). Wheat was most intensively consumed item, as it constituted 33.3% of total dry weight. Rice (10.4%) gram (6.8%), pulses (3.0%) maize(2.5%)

and insects (8.6%) were among the other better consumed items. A significant portion (7.4%) of the rats diet comprised of miscellaneous items.

From sweet shops 84 animals were captured. A total of 17 plants food items were recorded from their stomach contents (Table 1). Of these, wheat constituted 24.2% of the total dry weight of the contents. Rice (17.2%) , gram (10.2%), and insects (11.5%) were the other major food items of the rat. Pulses (5.7%) and T. foenum (4.5%) were eaten neither so intensively nor regularly. All other plant foods were eaten only sparingly. Unidentified plant tissues, unidentified food items, and miscellaneous items accounted for 9.6%, 5.4%, and 3.8%, respectively.

From grocery shops 83 animals were captured. In the stomach contents of these specimens 18 species of plants were represented (Table 1). Wheat was intensively consumed but not so intensively as it was consumed by the rats of the other structures as this grain accounted for 22% of the diet against 16.7% of rice. Other sources, namely, gram (3.8%), pulses (2.7%), maize (1.1%), lineseed (2.1%), brassica (1.6%), and fruits (1.1%) contributed relatively very little towards the diet of the rat. Insects (16.7%), unidentified plant tissues (18.2%), unknown matter (5.9%), and miscellaneous items (4.3%) together contributed 28.4% of the total weight of the stomach contents.

Season-wise wheat was consumed most intensively round the year. The second best consumed item was rice which was also eaten round the year at a more or less uniform rate. Next were insects which constituted an important portion of the annual diet of the rat. Gram seeds and unidentified plant tissues were the other staples of the rat's diet. Food of unknown origin and miscellaneous items were regularly represented in the seasonal samples of stomach contents.

Irrespective of the season and type of the structure, wheat was the best consumed item as it accounted for 33.7% of the total dry weight of the diet. Rice(15.6%), insects (11.6%), unidentified plant tissues (9.3%), and gram (6.9%) jointly accounted for 43.4% of the diet. The remaining 22.9% of the diet was due to a variety of items of which pulses (2.9%), maize (1.7%), and food matters of unknown nature (4.0%) were the main components (Table 2).

Berger-Parker Index was used to assess diversity in the diet of the rat (Table 3). The summer and spring diets of rat were less varied as compared to those of the fall and winter ones. The rats living in grain shops and houses tended to have more diversified diet than those living in other structures (Table 4).

In grain shops, residential houses, sweet shop and grocery shop, cereals and other eatables constituted 63%, 76%, 50% of the diet. This data in combination with the information provided by other workers, on population density and rate of consumption of food by the rat was used to estimate the quantity of cereals the rats plunder in various types of structures in Faisalabad city.

Ahmad _et al._ (1988) reported that an average house rat eats about 12.5 g of cereals per day. In the grain shops, residential houses, sweet shops and groceries of the present study areas, cereals etc. constituted 63%, 59%, 76%, and 50% of the rat's diet. In Table 5 is given the estimate of rat population in each of these structures. From the above data on consumption rate and population density it was computed that the rats deprived an average grain shop, residential houses, sweet shop and grocery shop of 49 to 72 Kg, 32 to 37 Kg, 24-48 Kg, and 59 to 78 Kg of cereals per year e 1. Annual Diet of the rat caught from different structures. The figures in parentheses under each structure type are number of occulars examined.

items	Grain shops (1300)	Houses (1280)	Sweet shops (840)	Grocery shops (830)
	% dry weight			
t	31.2	33.3	24.2	22.0
	14.9	10.4	17.2	16.7
	10.4	6.8	10.2	3.8
e	2.0	2.5	0.6	1.1
es	2.0	3.0	5.7	2.7
et	-	3.0	1.3	0.5
ey	-	-	-	0.5
	-	+	-	-
hum	1.3	0.6	+	0.5
eed	+	-	+	2.2
leracea	+	1.2	1.0	+
osnum	0.6	0.6	4.5	+
sica	2.0	0.6	0.6	1.6
r cane	2.6	1.2	-	0.5
lbum	-	0.6	0.6	0.5
ativum	-	-	0.6	0.5
lexandrinum	1.3	+	-	-
ander	1.3	+	1.2	+
hus	0.6	0.6	0.6	0.5
nut	-	-	0.6	-
ts (seeds)	+	1.2	0.6	1.1
t tissues nown)	5.2	16.4	9.6	18.2
cts	14.3	8.6	11.5	16.7
alian tissues	-	-	0.6	-
own	3.9	3.0	6.4	5.9
ellaneous	6.5	7.4	3.8	4.3

Table 2. The diet of the city house rats captured from different structures June 1989 through May, 1990.

Food items	Occulars (4250)	Frequency	Rel.Density %	dry weight
Wheat	1852	44	0.58	33.7
Rice	1015	24	0.27	15.6
Gram	498	12	0.12	6.9
Maize	119	3	0.03	1.7
Pulses	217	5	0.05	2.9
Millet	68	2	0.02	1.2
Barley	11	+	+	+
Oat	3	+	+	+
Sorghum	30	1	0.01	0.6
Linseed	23	1	0.01	0.6
P. oleracea	23	1	0.01	0.6
T. foenum	83	2	0.02	1.2
Brassica	77	2	0.02	1.2
Sugar cane	74	2	0.02	1.[illegible]
C. album	20	1	0.01	[illegible]
L. sativum	16	+	+	+
T. alexandrinum	35	1	0.01	[illegible]
Coriander	46	1	0.01	0.[illegible]
Sonchus	41	1	0.01	0.6
Coconut	5	-	-	-
Fruits (seeds)	39	1	0.01	0.6
Plant tissues (unknown)	625	15	0.16	9.3
Insects	754	18	0.20	11.6
Mammalian tissues	10	+	+	+
unknown	302	7	0.07	4.0
Miscellaneous	349	8	0.08	4.7

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Table 3.. Berger-Parker index of diversity in the seasonal samples of the contents of the contents of stomach of *R. rattus*

Food items	Summer	Fall	Winter	Spring
Wheat	798	1692	806	885
Rice	519	1347	685	329
Gram	254	553	331	94
Maize	14	109	86	47
Pulses	135	163	233	52
Millet	30	106	28	-
Barley	-	39	-	-
Oat	27	-	-	-
Sorghum	75	35	79	109
Linseed	2	6	9	-
P. oleracea	22	-	-	-
Methi	1	9	12	206
Brassica	4	89	86	175
Sugar cane	4	19	56	333
C. album	2	75	-	12
L. sativum	-	-	5	-
Barseem	20	11	3	1
Coriander	-	41	54	72
Sonchus	12	37	12	-
Coconut	-	10	-	-
Fruit seeds	17	30	57	50
Plant tissues	374	1650	409	84
Insects	289	804	490	84
Mammalian tissues	10	-	-	-
unknown	225	273	244	200
Miscellaneous	72	440	168	400
No. of food items (S)	22	22	20	17
Total No. of food (N) particles	2906	7538	3853	3385
Maximum abundant food items (Nmax)	798	1692	806	885
Berger-Parker index $d = N_{max} / N$	0.274	0.224	0.209	0.261
1/d	3.64	4.46	4.78	3.82

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Table 4. Berger-Parker index of diversity in the contents of stomach of Rattus rattus captured from different habitates.

Food items	Grain shops	Houses shops	Sweet shops	Grocery shops
Wheat	1281	1343	721	838
Rice	904	523	743	709
Gram	342	389	352	149
Maize	28	77	61	90
Pulses	65	188	181	149
Millet	-	126	-	38
Barley	-	-	-	39
Oat	-	27	-	-
Sorghum	116	57	72	53
Linseed	6	-	4	7
P. oleracea	-	22	-	-
T. foenum	-	2	206	-
Brassica	107	169	34	44
Sugar cane	97	250	48	17
C. album	-	48	-	41
L. sativum	-	-	5	4
T. alexandrinum	24	7	4	-
Coriander	158	2	7	-
Sonchus	22	30	6	3
Coconut	-	-	10	-
Fruit (seeds)	56	33	13	50
Plant tissues	325	968	426	798
Insects	660	475	362	422
Mammalian tissues	-	-	10	-
unknown	225	370	126	219
Miscellaneous	348	429	156	146
No. of food items (S)	17	21	21	19
Total No. of food (N) particles	4764	5555	3547	3819
Maximum abundant food items (Nmax)	1281	1343	743	838
Berger-Parker index $d = N_{max}/N$	0.268	0.241	0.209	0.219
	3.73	4.14	4.78	4.56

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Table 5. Estimates of annual consumption of food grain by house rats in different types of structures.

Structure type	Estimated No. of rats/ structure	Food grains consumed structure/year (kg)
Grain shops	17-25*	49-72
Residential houses	11-14*	32-37
Sweet shops	7-14**	24-48
Grocery shops	25-33**	59-78
Combined	15-22	48-67

* Ali (1990)
** Khan (1990)

PROJECT TITLE: Food Habits of the Indoor Segments of House Mouse Population.

STUDENT:

Name: Shamim Akhtar Rana

Degree: M.Phil.

INTRODUCTION:

The house mouse (Mus musculus) infests both indoor as well as outdoor habitats in Pakistan. In indoor situation, the mouse feeds and contaminates stored food stuffs. In the fields, it damage food crops like wheat and rice right from sowing till harvesting. It is usually difficult to obtain accurate estimates of losses the mice inflicts on food stuffs and crops.

OBJECTIVE:

This study is aimed at knowing the food habits of the mouse caught from buildings and houses located in urban and rural areas of central Punjab.

ACCOMPLISHMENTS:

From 1987 through 1990, specimens of the house mouse (Mus musculus) were collected from a variety of structure types from urban (Faisalabad city) and rural areas of the central Punjab. The stomach contents of these mice were examined to know their diet. Figs. 1 and 2 provide information on the annual diet of the house mouse living in city and village houses.

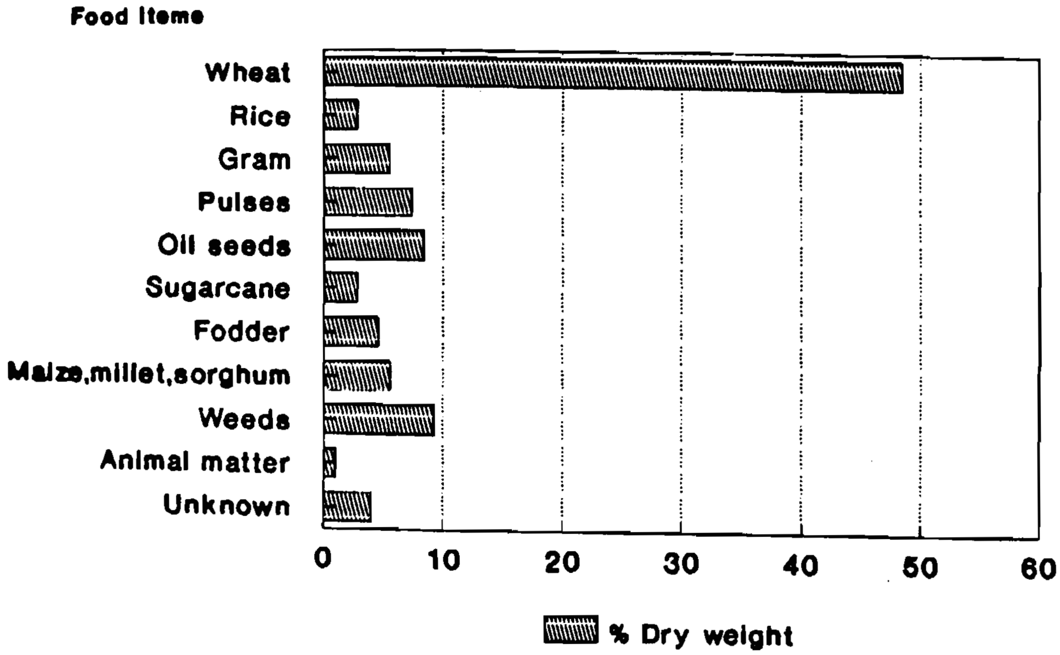
Stomach analysis of the mice captured from the city houses showed that during the summer season mice largely depended on wheat for their food as it constituted 52.1% of the total dry weight of the stomach contents. Weeds, pulses and rice were eaten consistently but in much smaller amounts. In the mice from village houses wheat accounted for 50.6% of the summer diet, maize, sorghum and rice were eaten consistently but in only small quantities. The diet of city mice in autumn consisted mainly of wheat (46.5%). Weeds, pulses and plants were also eaten. The village mice supplemented their wheat (50.5%) dominated diet, with weeds, rice, pulses oil seeds and fodders.

During the winter season the city mice showed no change in their diet as wheat (46.9%), pulses, oilseeds and fodders contined to be their staples. The villages house mice consumed wheat (59.3%) more intensively than in the previous season (autumn). Fodder, pulses and weeds consistently supplemented the winter diet. The spring diet of the city mice mainly comprised of wheat which constituted 66.3% of the total dry weight of the diet. Animal food was also consumed by these mice. The spring diet of the village mice was mainly due to wheat which accounted for 72.3% of the total dry weight. Pulses, fodder, rice and oil seeds were among the other consistently consumed items.

The mice living in the grocer's shops largely depended on rice (47.9%) for their food. Wheat and pulses were the other two staples of the diet of these mice (Fig. 3). In the grain market rice was eaten intensively as it accounted for 49.0% of its total dry weight; wheat (35%) and gram (16%) being the other two regularly consumed items. The mice from the sweet shops largely depended on wheat flour which constituted (90.8%) of total dry weight.

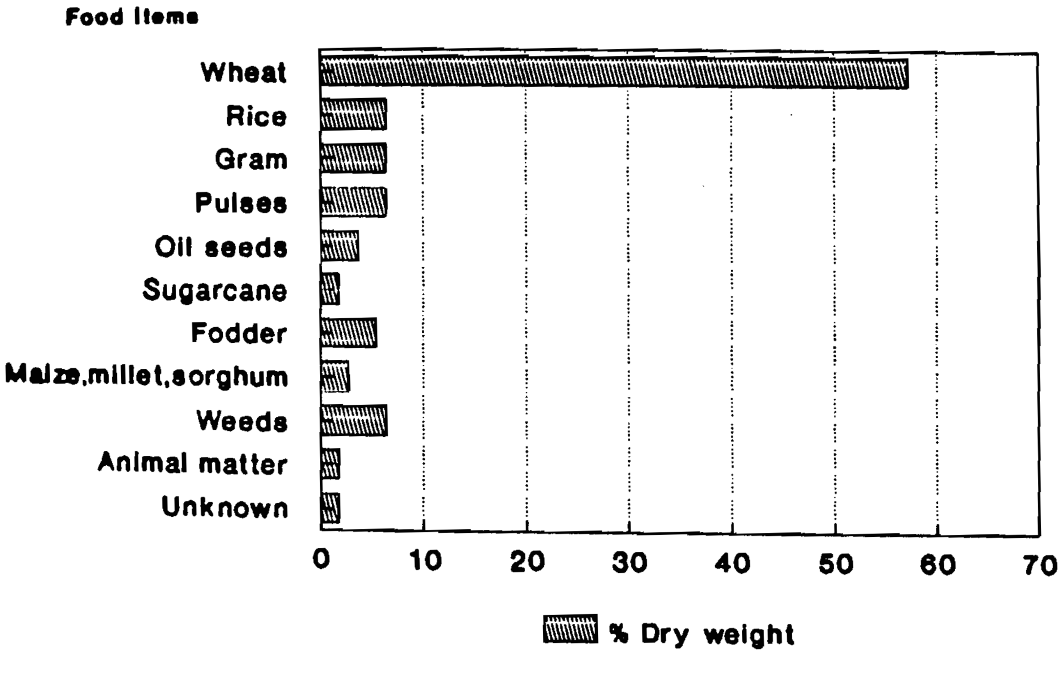
The mice caught from the village shops largely depended on wheat which accounted for 46.3% of the total dry weight of their stomach contents. Pulses, weeds, rice and oil seeds were also taken regularly(Fig.4). In the poultry farm, maize constituted 34.6% of the diet of mice. Wheat, weeds and rice were also eaten regularly (Fig. 5). In the mice from the flour mills accounted for 91.0% of the total dry weight of the diet; gram and maize being the other staples. The specimens from the farm houses depended mainly on wheat 54.8% and seeds of weeds (22.1%), sugarcane and fodder plants were the other important components of the diet of these mice (Fig. 6).

Fig.1.Relative dry weight of major food items present in the stomach contents of House mice*.



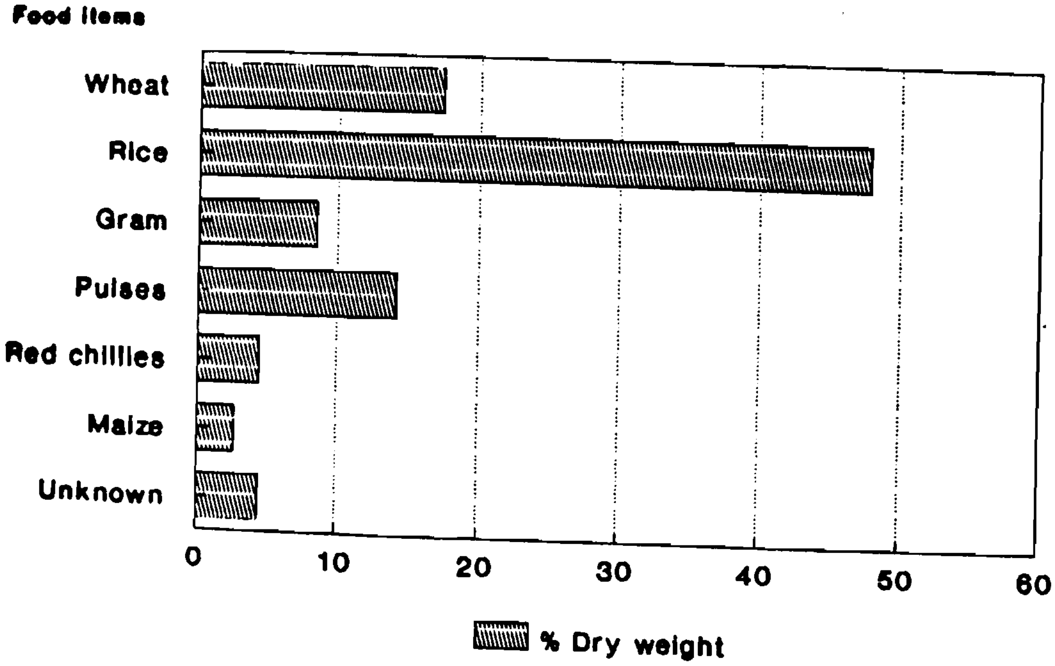
* House mice were captured from residential houses in Faisalabad city.

Fig.2.Relative dry weight of major food items present in the stomach contents of House mice*.



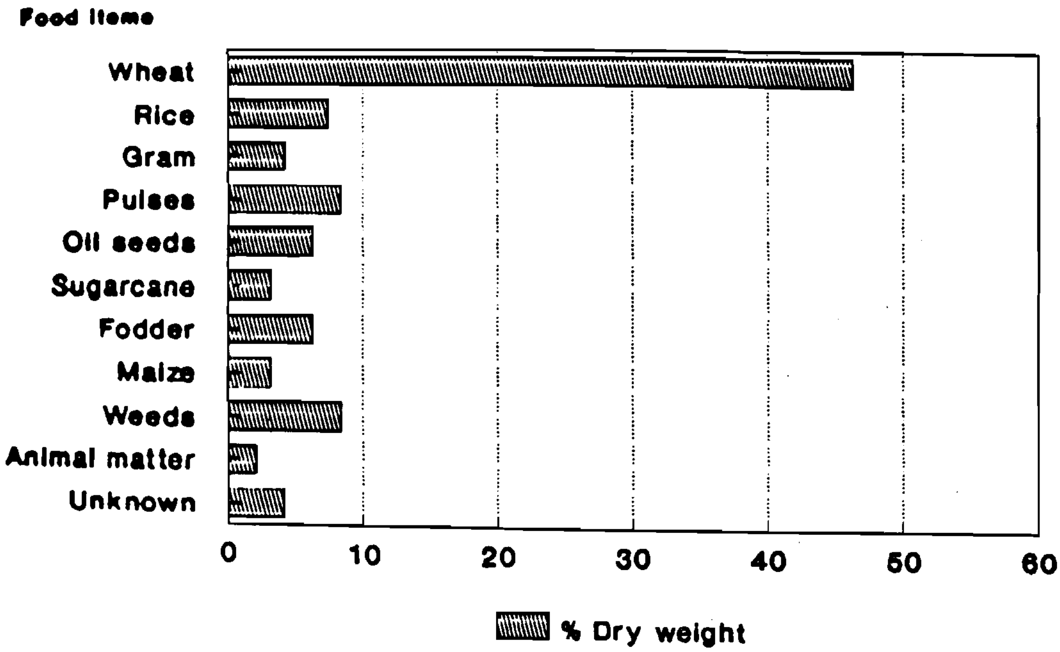
* House mice were captured from village houses of central Punjab.

Fig. 3.Relative dry weight of major food items present in the stomach contents of House mice*.



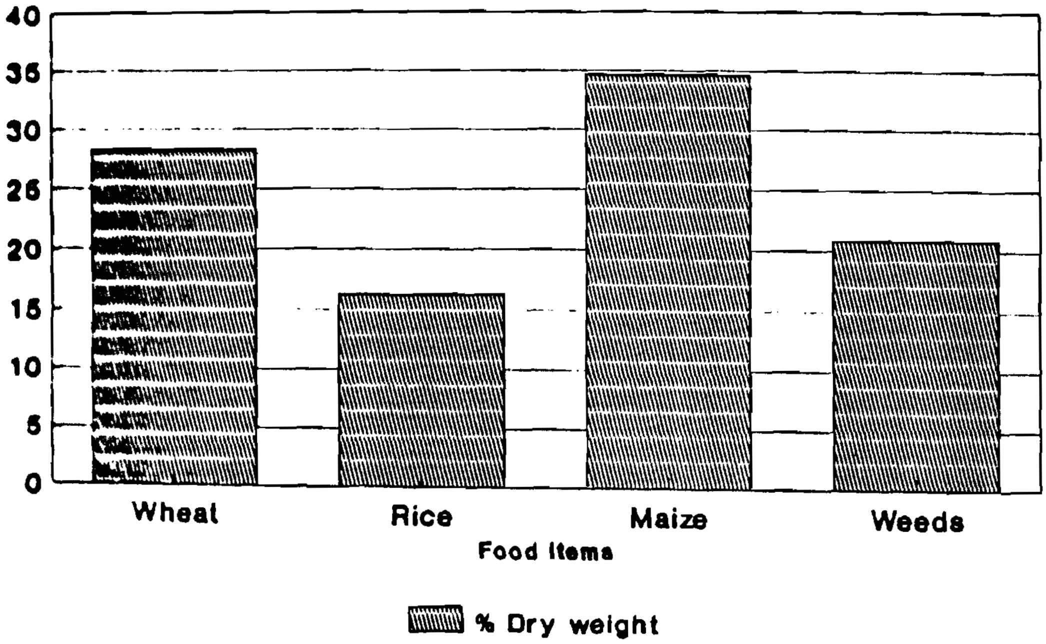
* House mice were captured from grocer shops of Faisalabad city.

Fig. 4. Relative dry weight of major food items present in the stomach contents of House mice*.



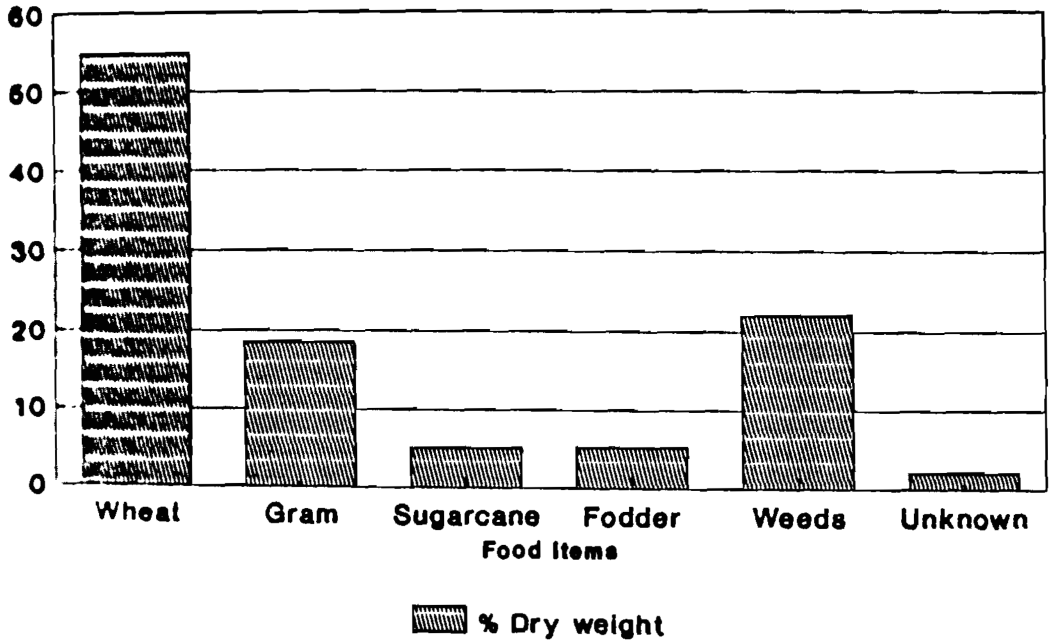
* House mice were captured from village shops of central Punjab.

Fig.5.Relative dry weight of major food items present in the stomach contents of House mice*.



* House mice were captured from poultry farms of central Punjab.

Fig.6.Relative dry weight of major food items present in the stomach contents of House mice*.



* House mice were captured from the farm houses of central Punjab.

PROJECT TITLE: Controlling rats and mice in farmla with Wheat-Sugarcane-Fodder pattern cropping.

STUDENT:

Name: M.Khalid Mukhtar

Degree: M.Phil.

INTRODUCTION:

The rats and mice living in the croplands show considerable changes in their population densities. These changes are related to seasonal variations in the growth rates of the populations themselves and the size of the available habitat. During certain times of the year, especially following harvesting and ploughing of the fields, the size of suitable habitats suddenly shrinks. For example, in the month of November, the rats and mice of the croplands of central Punjab become largely confined to smaller areas under sugarcane, fodder (leguminoid), and vegetable crops. During this month, most of the fields that had been under sugarcane, fodder (graminoid), and cotton crop are ploughed and prepared for the sowing of the wheat crop. Furthermore, as the weather turns cool, the rats cease reproducing and they continue to do so throughout winter season. The only exception is the house mouse which reproduces during winter season but at a much slower rate. So the hypothesis is-if the November concentrations of these murids in sugarcane, vegetable and fodder fields are destroyed, there will be a little chance for them to build up their populations till the harvesting of the wheat crop in late April. As food and shelter conditions are fast improving and the rodent populations are concomittantly declining during the winter season, any possibility of massive immigration from nearby unprotected fields may not be significant. The present study was aimed at testing the above hypothesis.

OBJECTIVES:

To protect the wheat crop against rats and mice

ACCOMPLISHMENTS:

Towards the fag end of November (1990), 20 acres of fields (under sugarcane, fodder and vegetable crops) in a 150 - acre block (treatment block) of cropland were treated with zinc phosphide baits. As a matter of fact the baiting was done to protect the wheat crop during the following winter and spring seasons when a total of 90 acres was sown to wheat.

Both the treatment and control blocks were sampled thrice for rats and mice (Table 1). Damage to the wheat crops of the two blocks was estimated in the third week of April (1991) using a 50 cm x 50 cm quadrat. About 1.5% of the wheat hills in the treatment block and 4.4% in the control block were found to have cut tillers in them. In the treatment block 0.81% of the tillers had been damaged as compared to 3.05% of the control block (Table 2). Thus, 2.24% of the wheat tillers of the treatment block were saved from being destroyed by the rodents.

The average per acre yield for the wheat fields of the treatment blocks was 1400 Kg. It was computed that in each acre of the treatment wheat fields, 31.4 Kg of the wheat grain was saved from becoming food of the rodents. It was further computed that a net saving of Rs. 8,588 was made by providing protection to the 90 acres of the wheat fields of the treatment block (Table 2).

The late November baiting provided only a nominal protection to the cane crop. The rats attack the canes mainly in October and early November. Moreover, by late November most of the cane fields are harvested. In order to make the present control programme more cost effective by extending protection to the cane crop also, it is proposed to carry out poison baiting twice - once in early October in cane fields only and once again in late November in cane, vegetable and fodder fields.

Two treatment blocks (T_1 and T_2), each of 150 acres in size have been earmarked since late spring (1991) for carrying out the experiment on the lines spelled out earlier. T_1 and T_2 are located near 128 J.B. and 61 J.B., whereas a control block of similar size (C) is located near 130 J.B. All the three blocks are located within 30 km of Faisalabad city.

Randomly selected wheat fields in all the three blocks were sampled using 50 cm x 50 cm quadrats during the last week of April (1991) and first week of

May (1991) . The method of sampling was the same as described in Khan (1990). Twenty-five , 30, and 17.5 acres of wheat fields were sampled from T_1, T_2 and C using 250, 300, and 175 sampling quadrats, respectively. The respective proportion of quadrats having cut tillers was 74% , 38%, and 51% (Table 1). It was also estimated that 14% , 5%, and 11% of the wheat tillers had been cut by rats and mice in T_1, T_2 and C blocks respectively (Table 2).

Soon harvesting, randomly selected wheat fields from the treatment and control blocks were sampled for the burrows of Bandicota bengalensis and Tatera indica. The sampling was done from May 15 through May 20. It was estimated that an average acre of the wheat fields of T_1, harboured 37.2 bandicoot and 1.3 gerbille burrows, of T_2 7.3 bandicoot and 1.5 gerbille burrows, and of C 12.6 bandicoot and 0.5 gerbille burrows.

The next summer (1991) all the three blocks shall be sampled (using snap traps) for knowing the abundance and composition of rodent fauna in the various crops. The sugarcane fields of the treatment blocks shall be regularly checked for rodent damage to the canes. This will help in determining the timing of poison baiting in the cane fields of T_1 and T_2. Rodent damage to the canes of the treatment and control blocks shall be estimated in November and compared to assess the efficacy of poison baiting in the cane fields. Similarly, trapping data obtained in November from the three blocks shall be compared for rodent abundance and composition.

Finally, the cane fields of the two treatment blocks shall be poison baited in late November to prevent emigration of rats and mice to the wheat fields. The wheat fields of all the three blocks will be sampled for rats and mice in March, for rodent damage in April and for rat burrows in May. A comparison of the data from the treatment and control blocks and from 1991 and 1992 shall help in assessing the efficacy of the present control strategy which has apparently the following advantages:

1. Poison is used over an area much smaller that is under wheat.

2. Poison baiting in November gaurantees sufficient protection to the wheat crop from sowing till harvesting.

3. The strategy is not only cost effective but is also ecologically desirable as it is less damaging to the wildlife living in the croplands.

Table 1. Trapsuccess of rats and mice on the treatment and control blocks before and after the application of zinc phosphide bating in the treatment block.

Trapping	Trapping time	Animal caught	Trapsuccess(%) Treatment block	Trapsuccess(%) Control block
1. Pre-treatment	Nov 16-20, 1990	*M. musculus*	7.0	7.7
		R. meltada	2.7	0.7
		B. bengalensis	0.7	0.7
		Total	10.4	9.1
2. 1st Post treatment	Dec 10-16, 1990	*M. musculus*	1.5	8.3
		R. meltada	0.2	0.5
		B. Bengalensis	0.0	0.0
		Total	1.7	8.8
3. 2nd Post treatment	Mar 19-23, 1991	*M. musculus*	2.2	5.2
		R. meltada	0.7	0.5
		B. bengalensis	0.0	0.0
		Total	2.9	5.7

Table 2. Assessment of rats and mice damage to ripe wheat crop of the treatment and control blocks.

	Wheat Fields	
	Treatment block	Control block
Area sampled(acres)	20	20
Sample quadrats	200	200
No.hills examined	4455	3851
No.with cut tillers	65	170
% hills with cut tillers	1.46	4.41
No.tillers examined	13007	10300
No.cut tillers	111	0.314
% cut tillers	0.81	3.05

Table 3. Cost-benefit statistics of the strategy employed for saving wheat crop from rat and mice depredation.

Av.yield of wheat in treatment field.............1400 Kg/acre

Wheat saved from rats and mice..................31.4 Kg/acre

Wheat saved on 90 acre of the treatment block....2826 Kg

Wholesale price of 1 Kg Of wheat(in June 1990)...Rs.3.30

Cost of 2826 Kg of wheat field..................Rs.9326.00

Total expenditure on poison baiting.............Rs.738.00

Net saving......................................Rs.8588.00

Table 4. Portion of quardrats showing cut tillers of wheat in the samples from treatment (T_1 and T_2) and contrl (C) blocks.

	T_1	T_2	C
No.of sampling quadrats	250	300	175
No.of quadrats having cut tillers	186	144	89
% quadrats having cut tillers	74	38	51

Table 5. Estimate of rodent damage to the wheat crop in the treatment (T_1 and T_2) and Control (C) Blocks

	T_1	T_2	C
No.of tillers examined	23792	24154	8229
No.of cut tillers	3230	1271	901
% cut tillers	14	5	11

Table 6. Estimate of burrow density of B.bengalensis and T.indica in harvested wheat fields of the treatment (T_1 and T_2) and control (C) blocks.

	T_1	T_2	C
Area (acre) of Wheat fields sampled	31.00	42.75	27.50
No. of burrows			
B.bengalensis	1154	311	346
T.indica	39	63	13
Burrow density			
B.bengalensis	37.20	7.30	12.60
T.indica	1.30	1.50	0.50

PROJECT TITLE: Relative density and control of Indian crested porcupine (*Hystrix indica*) in central Punjab.

STUDENT: Muhammad Siddique, M.Phil. degree programme.
Faqir Muhammad, M.Sc. degree programme

INTRODUCTION:

Before the massive development of canal irrigation in Punjab at the turn of the present century, the Indian crested porcupine (*Hystrix indica*) inhabited the tropical thorn forest. The carrying capacity of the region (which was formerly vegetated with the thorn forest) has been sustantially raised by the introduction of canal irrigated agriculture. Recent studies on the distribution and abundance of porcupine burrows show that the porcupine largely resides in the embankments of drainage canals and forest plantations. From these sites, they regularly visit the nearby farms in the course of their nocturnal foraging trips and cause extensive damage to maize, potato, sweet potato, and sugarcane . These agricultural crops as well as the plantation trees that are detbarked must be protected against the porcupine. In order to achieve this end we need to have an ecologically acceptable method for inhibiting the porcupine population as well as a method for monitoring trends in its population following a reduction programme.

OBJECTIVES:

1. Standarize food station transect method with respect to porcupine so that seasonal and annual trends in its relative density could be known.

2. Co-relative the estimates of relative density with the density of active porcupine burrow systems.

3. Develop a method for reducing the porcupine population by using a toxicant(s) and monitor the population following removal.

ACCOMPLISHMENTS:

Four transects, two along a drainage canal near Chakku Forest, Jaranawala and two in a forest plantation near Lalian, near Rubwah, began operating from February(1990) and March (1990), respectively. A third transect was added to each of the two localities in April and May respectively. All six transects consisted of 10 bait stations each. Bait stations, were placed at about 100 m intervals. The transect were run for four consecutive nights on biomonthly babsis from February/March,1990 through February/March,1991. The drainage canal transects could not be run during the months of August and October whereas the forest plantations transects remained inoperable during the month of September due to some student problem on the University Campus.

Table 1 provides information about the number of operable stations nights, number of food stations visited by the porcupines and visitation index (i.e. % stations visited by porcupines) for each of the food baiting sessions at the three drainage canal transects. Transect 1 had higher visitation index (66%) than transects 2(60%) and 3(40%) . The average index value for the three transects was 57%.

Table 2 provides a similar information about the forest plantation transects. The visitation index values for transect 1 was 32% as compared to 40% and 43% of transects 2 and 3. The average index value for the three transects was 38%.

Figure 1 a shows that the visitation index values in the drainage canal transects generally increased from February through November. Highest index values were recorded in November or December past which they declined. More or less a similar pattern was observed for the forest plantation transects (Fig. 1 b). The index values for these transects generally increased from March(1990) through January (1991) when the highest average index value was recorded.

Relatively high index values in December through March might have been related to the weaning of the young porcupine and their aboveground appearance. Unfortunately, there are no data distinguishing foot prints of the young porcupines from those of the grown ones. Such a information help in substantiating this inference. It is also possible that with the passage of time more and more porcupines learned about the occasional availability of food at the transect stations and hence they visited them during their nightly foraging trips.

As noted earlier, the average index values for the drainage canal transects were higher than those of the forest plantation transects (Fig. 2). All the three drainage canal transects were located much closer to porcupine burrows than the forest plantation transects. Furthermore, the embankments of the drainage canal were more heavily infested with porcupine burrows than the forest plantations. Perhaps, these two factors were possible for high index values for the drainage canal transects.

One Night Versus Four Nights Of Operation

Table 3 and Fig. 3 a,b document information about changes in the visitation index values from day one to day four of the operation the drainage canal and forest plantation transects . The drainage canal transects showed little improvement over the first day index value during the remaining three days of the station baiting. In the case of transects 1 high index value of 70% was recorded on day one. In the case of transect 2 the highest index value of 65% was was recorded on the fourth day. This gain of 10% occurred gradually over the four days of station baiting. In the case of transect 3, the best index value (41%) was recorded on day two. It was nearely 4% better that than the the one recorded on day one. The average values for these three transects ranged between 54% and 56%.

Things were slighly different in the case of the forest plantation transects. On day one the index value for transect 1 was 31% as compared to the maximum of 38% on day four. In the case of transects 1 and 2, index values for day one was 42% and 40% which gradually increased over the remaining three days to 56% and 53% , respectively. So the respective gains were 14% and 13%.

It may, therefore, be concluded that in the case of drainage canal transects one night of station baiting was sufficient to achieve maximum or near maximum index values. In the case of forest plantation transects, four days of operation was necessary to achieve the "maximum" index values. Perhaps, the plantation transects needed a couple of more days to reach the maximum. The difference in the bahaviour of the porcupine of the drainage canal and forest plantation porcupines vis-a-vis the food stations may be related to the average relative distance of the porcupine burrows to the transects.

The porcupine burrows in both the areas have been mapped . Since the start of these studies an attempt shall be made to correlate the burrow density and distance to index value obtained for a given transect. The next important step in connection with this research work would be to see the effect of poison baiting on the food station on the index values and the number of active porcupine burrows.

Table 1. Bimonthly visitation index for the porcupines of the drainage canal embankment.

Transect	Feb(1990)	Apr(1990)	Jun(1990)	Nov(1990)	Dec(1990)	Feb(1991)	Combined
Transect 1							
No.operable Station nights	40	40	40	40	40	40	240
No.porcupine visits	22	25	26	33	30	22	158
Visitation Index	55	63	65	83	75	55	66
Transect 2							
No.operable station nights	-	40	40	40	39	39	198
No.porcupine visits	-	6	22	31	28	32	119
Visitation index	-	15	55	78	72	82	60
Transect 3							
No.operable station nights	40	40	40	40	38	40	238
No.pocupine visits	12	7	10	22	27	16	94
Visitation index	30	18	25	55	71	40	40
Combined							
No.operable station nights	80	120	120	120	117	119	676
No.porcupine visits	34	38	58	86	85	85	386
Visitation index	43	32	48	72	73	59	57

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Table 2. Bimonthly visitation index for the porcupines of the forest plantation.

Transect	Mar(1990)	May(1990)	Jul(1990)	Nov(1990)	Jan(1990)	Mar(1991)	Combined
Transect 1							
No.operable Station nights	39	40	30	40	40	39	228
No.porcupine visits	10	10	7	11	17	18	73
Visitation Index	26	25	18	28	43	46	32
Transect 2							
No.operable station nights	40	40	30	40	40	40	230
No.porcupine visits	4	11	13	21	23	19	91
Visitation index	10	28	43	53	58	48	40
Transect 3							
No.operable station nights	-	40	30	40	40	40	190
No.pocupine visits	-	9	9	16	24	24	82
Visitation index	-	23	23	40	60	60	43
Combined							
No.operable station nights	70	120	90	120	120	119	648
No.porcupine visits	14	30	29	48	64	61	246
Visitation index	18	25	32	40	53	51	38

Table 3.Porcupine visit to active food stations by day of transcet operation.

	Drainage canal				Forest plantation			
	Day one	Day two	Day three	Day four	Day one	Day two	Day three	Day four
Transect 1								
No.active station	60	60	41	60	59	60	60	50
No.porcupine visits	42	41	39	36	18	17	19	19
Visit.index	70	68	65	60	31	28	32	38
Transect 2								
No.active station	49	50	50	49	59	60	60	50
No.porcupine visits	27	29	31	32	23	25	27	28
Visit.index	55	58	62	65	39	42	45	56
Transect 3								
No.active station	60	59	59	60	50	50	50	40
No.porcupine visites	22	24	22	24	18	20	23	21
Visit.index	37	41	37	40	36	40	46	53
Combined								
No.active station	169	169	169	169	168	170	170	140
No.porcupine visits	91	94	92	92	59	62	69	68
Visit.indix	54	56	54	54	35	36	41	49

Table 4. Visitation index values dogs-jackals, and rabbits for the drainage canal and forest plantation.

Transect	No. operable Sta. nights	Index value	
		Dog-Jackal	Rabbit
	Drainage canal		
1	240	3.3(8)	0
2	198	0.2(3)	0
3	238	3.8(9)	0
Total	676	3.0(20)	0
	Forest plantation		
1	228	3.9(9)	6.6(15)
2	230	3.5(8)	3.0(7)
3	190	4.7(9)	3.2(6)
Total	648	4.0(26)	4.3(28)

Fig.1.Trends in porcupine visitations to drainage canal embankment(a) and forest plantation(b) transects.

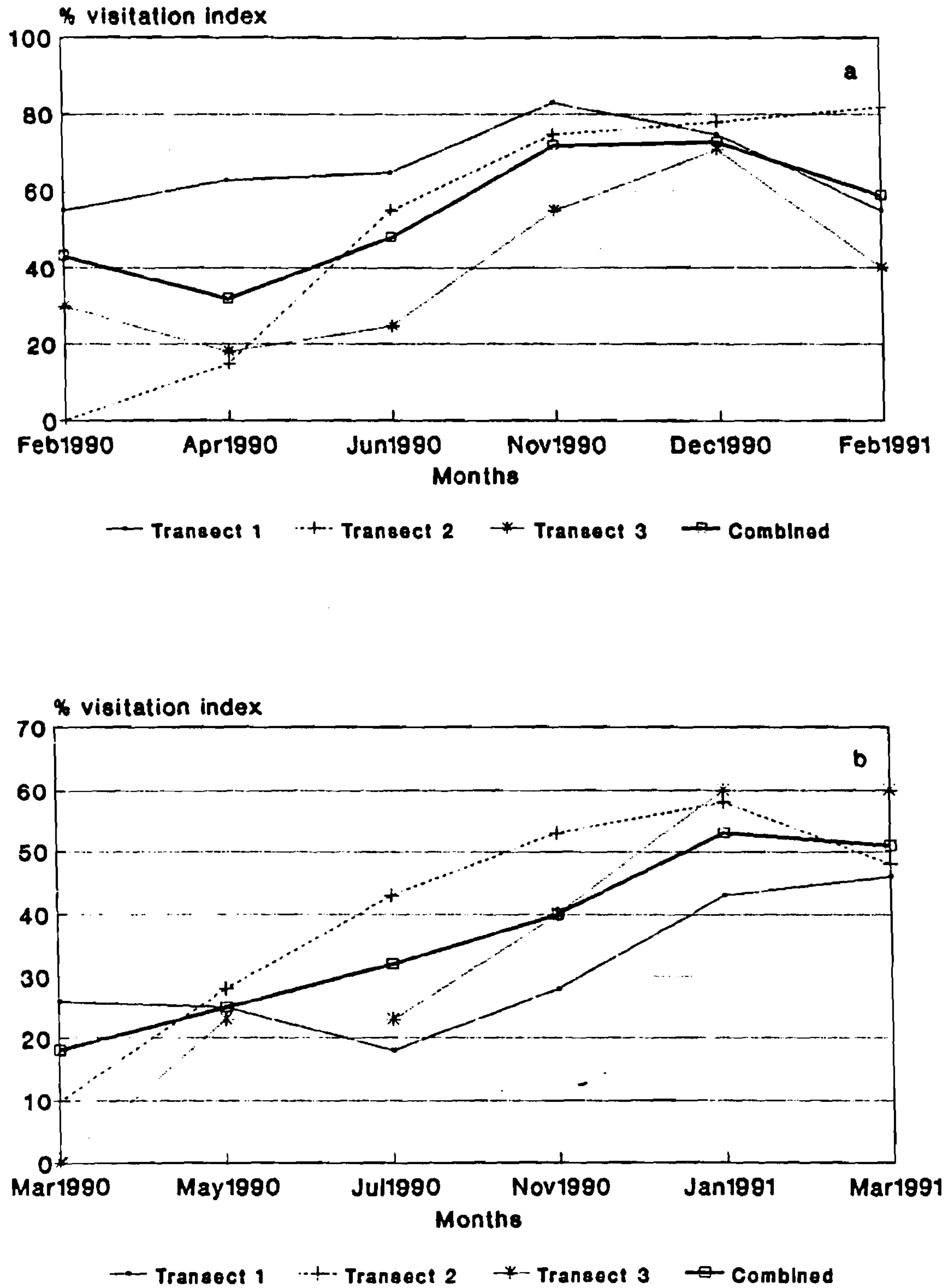


Fig.2.Average visitation indices of porcupine for drainage canal embankment and forest plantation transects.

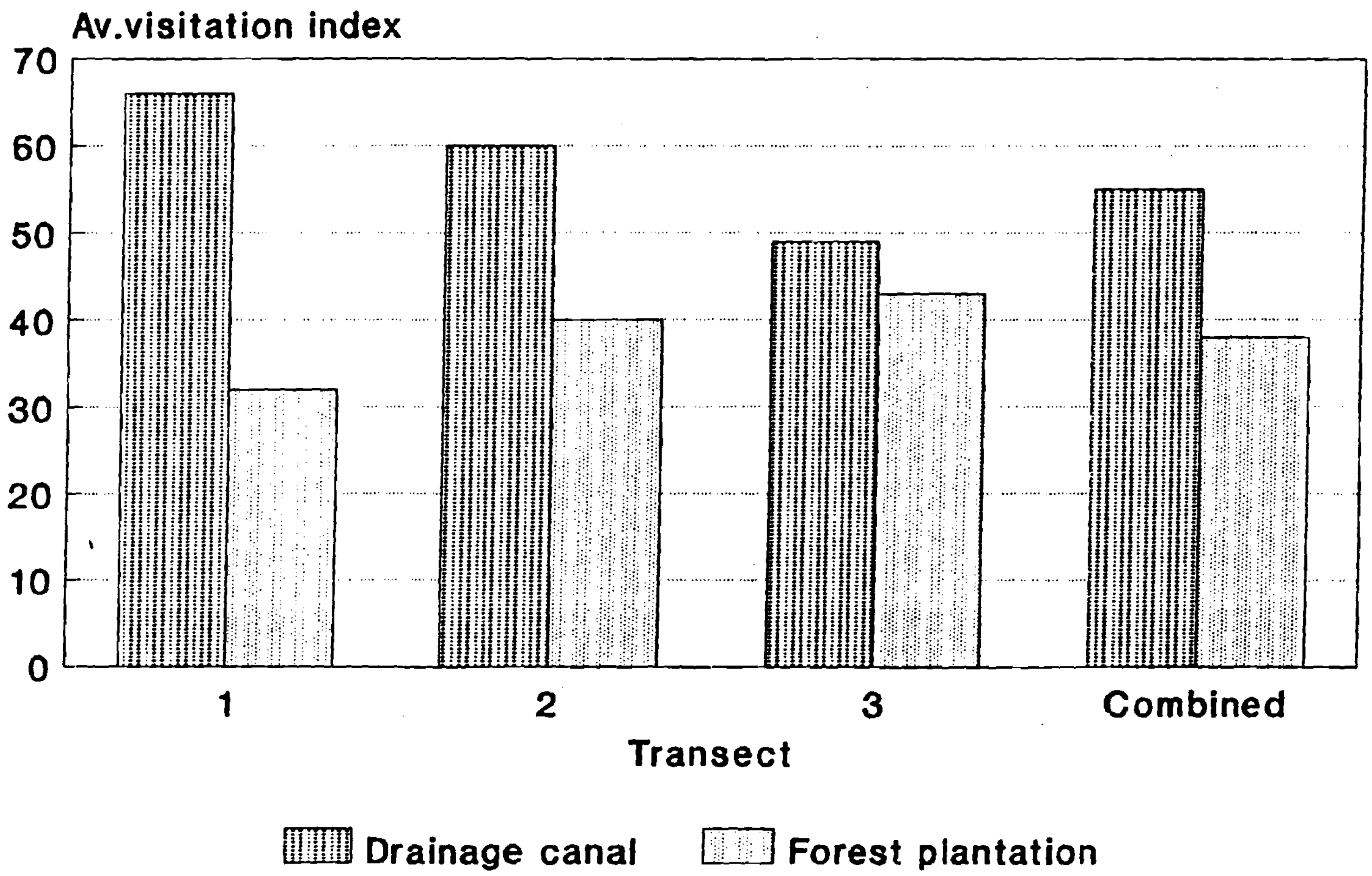
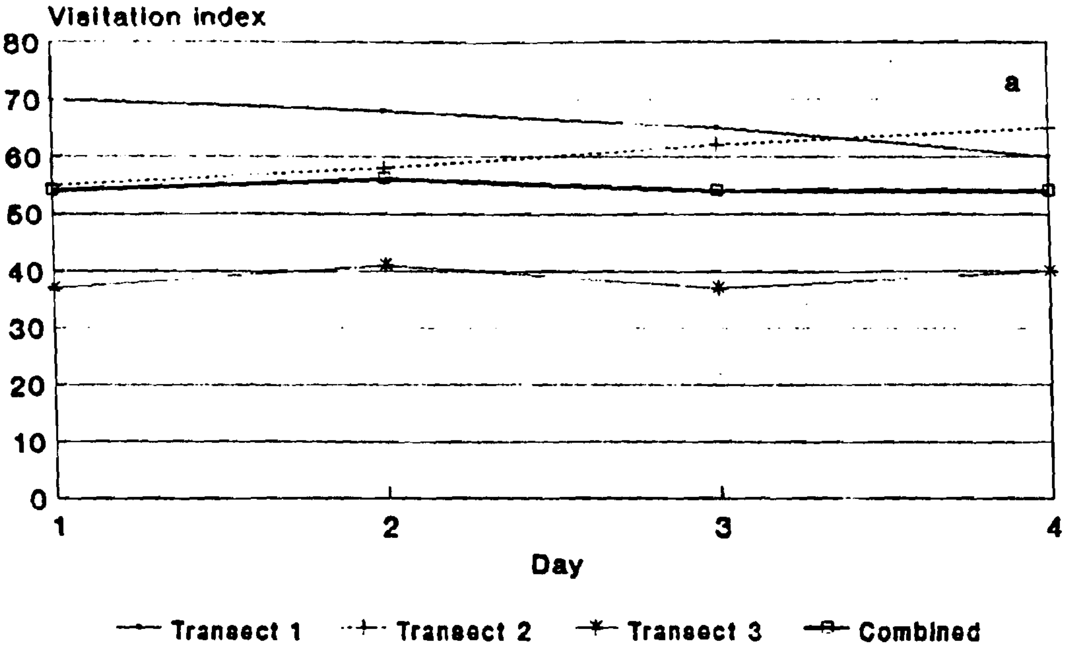
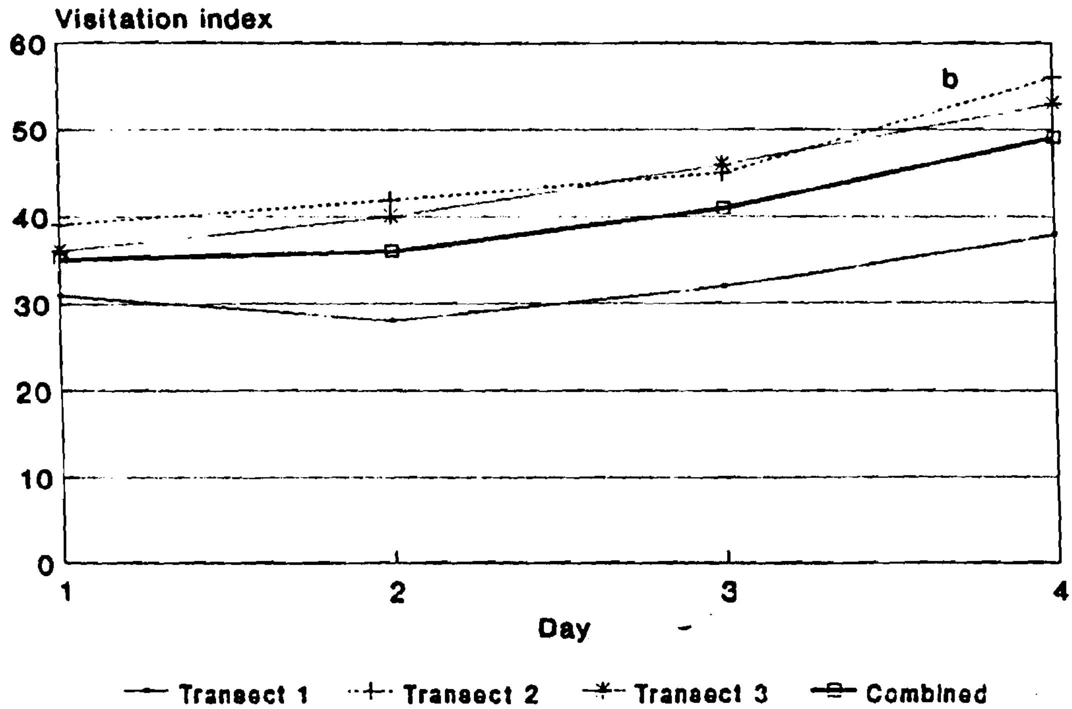


Fig.3.Visitation indices of porcupine by day for drainage canal embankment(a) and forest plantation(b) transects.





PROJECT TITLE: Studies on flock composition, flock formation and foraging and feeding habits of sparrows (*Passer* spp) in central Punjab.

STUDENT:
Name: Shafique-ur-Rehman
Degree: M.Phil.

INTRODUCTION:

During certain times of the year, especially when wheat and rice crops are maturing, huge flocks of the house sparrow (*Passer domesticus*) may be seen maruding these crops. At about the same time the migratory flocks of the Spanish sparrow seem to join the local population of the house sparrow forming enormous flocks. Samples from the marauding flocks of the sparrow may help in knowing their taxonomic composition and population structure.

Another important aspect of the ecology of the house sparrow in central Punjab is that it is not entirely dependent on food grains for it. Rather, seeds and other tissues of plants of less or no economic importance and insects reportedly make a significant part of the bird's diet. Examination of the contents of crops and stomachs of sparrows caught from the fields may help in knowing its true place in the food web of the agroecosystem and its economic status.

OBJECTIVES:

1. To obtain information about the taxonomic composition and population structure of sparrows (Passer Spp.)

2. To know about the diet of the house sparrow.

ACCOMPLISHMENTS.

This report provides information on the diet of the house sparrow as determined from the examination of the crop-stomach contents (= stomach contents) of the specimens captured during the fall and winter seasons from the croplands of central Punjab. Table 1 shows that stomach contents of only 68 and 35 specimens were available in the fall and winter samples. As a matter of fact the samples were much larger but good many of the contents were destroyed as the deep freezer in which they were preserved stopped working. The spring sample of stomach is still waiting analysis.

During the fall, the sparrow food comprised of Echinocloa, rice, wheat, sorghum, insects and some unidentified food stuff(Table 1). Echinocloa was represented in 47% of the stomachs whereas rice and wheat were present in 29% and 10% and insects in 7% of the stomachs. The winter diet apparently became less diversified as only rice and wheat were eaten during this season; the former was represented in 57% and the latter in 43% of the stomachs.

In the fall sample, an average stomach contained about 14 grains of cereals of which 81% was due to Echinocloa , 17% due to rice, and 2% due to wheat (Table 2). In the winter sample an average stomached contained 12 grains of which 73% was that of rice and 27% that of wheat. Numerically, the fall diet was slightly superior to the winter diet but in terms of biomass and perhaps also quality-wise the winter diet was better.

Information on flock composition and structure is also being collected.

Table 1. Frequency of occurrence of various food items in the crop and stomach of house sparrow caught during the fall and winter seasons. The number of stomachs examined was 68 and 35.

	Wheat	Echinocloa	Rice	Sorghum	Insects	Unidentified
			Fall (1990)			
No. stomachs represented in	7	32	20	1	5	11
% stomachs represented in	10	47	29	1	7	16
			Winter (1990-91)			
No. stomachs represented in	15	0	20	0	0	0
% stomachs represented in	43	0	57	0	0	0

Table 2. Intensity of consumption of ceral grains by house sparrows caught in fall and winter seasons.

Food items	Total No. of grains	No.of grains/stomach	Proportion
	Fall (1990)		
Wheat	18	0.26	.02
Echinocloa	767	11.28	.81
Rice	164	2.41	.17
Sorghum	1	0.01	-
	Winter (1991-90)		
Wheat	93	2.66	.27
Rice	249	7.11	.73

Table 1. Quadrate (50 cm x 50 cm) showing sparrow damage to ripe ears

Sampling site	Area sampled	No. sampling quadrates	No. quadrates showing damage	% quadrates showing damage
Chak 128 J.B. Tehsil Chinoit (Distt.Jhang)	25.0	250	18	7.2
61 J.B. (Distt. Faisalabad)	30.0	300	1	0.3
Chak 130 J.B. (Distt.Jhang)	17.5	175	2	1.4
Total	62.5	725	21	2.9

Table 2. An estimate of extent of damage to wheat ears.

% Damage to ears (X)	Frequency (F)	FX
0	50114	0
5	13	65
10	7	70
15	14	210
20	6	120
25	6	150
30	2	60
35	9	315
40	1	40
45	7	315
50	1	50
55	3	165
60	2	120
65	2	130
70	1	70
75	2	150
80	5	400
85	2	170
90	2	180
95	1	95
100	255	25500
Total	50455	28375
Mean		0.562382